MODIS SEA-SURFACE TEMPERATURES

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SUMMARY

- MODIS SSTs are stable and of good accuracy
- New algorithmic enhancements to improve accuracy, especially towards edges of swaths
- New V6 code delivered to OBPG and tested for next reprocessing cycle
- New M-AERIs being deployed for skin SST validation
- SI-calibration traceability leads to rigorous CDR generation
  - But desired CDR accuracies not yet met

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SST ACCURACY REQUIREMENTS

- SST is an Essential Climate Variable (CEOS)
- Required Errors and Uncertainties in SST for CDRs:
  - Accuracy: better than 0.1K
  - Stability: better than 0.04 K/decade
- SST CDRs require traceability to SI-Standards
- Difficulties are not only to achieve these, but to demonstrate whether they have been achieved
- "Reference satellite sensor" – AATSR – terminated in April 2012 with failure of Envisat – focus on MODIS

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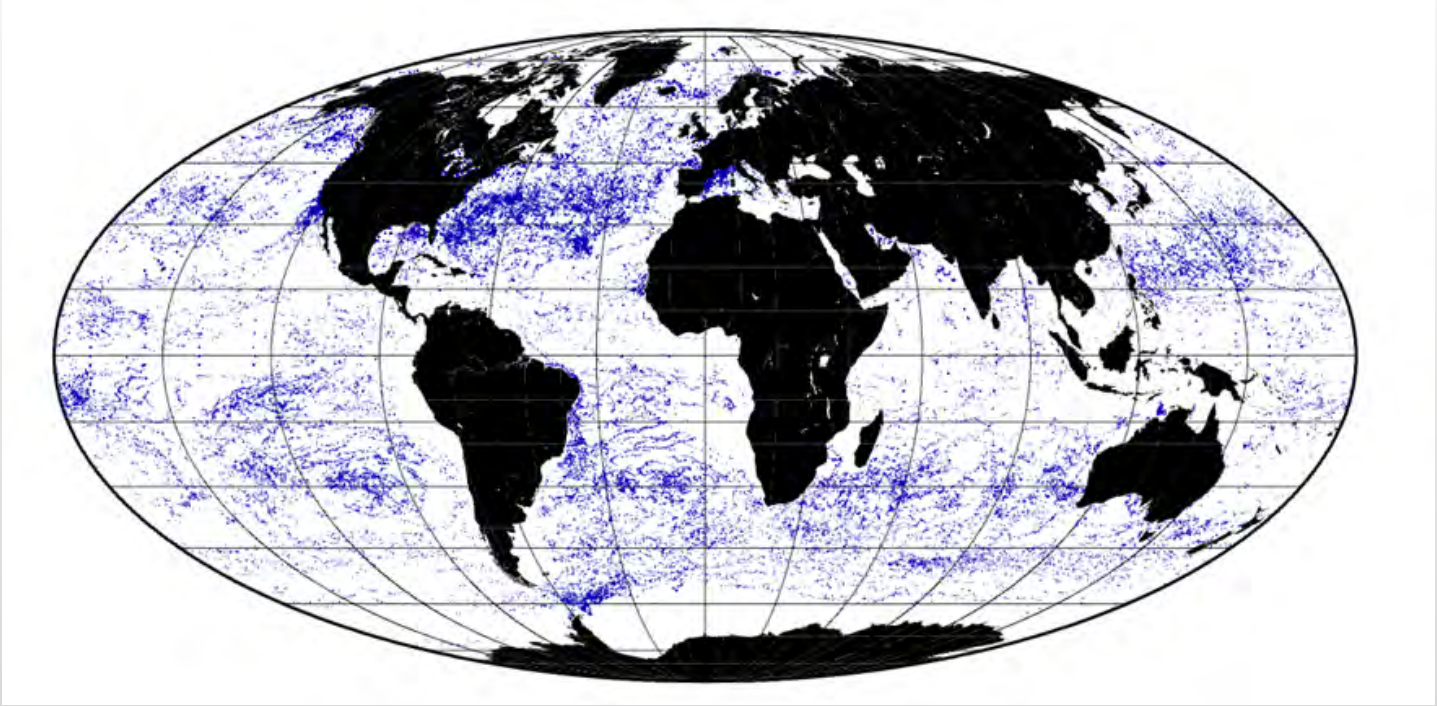
ATMOSPHERIC CORRECTION ALGORITHMS

Collection 5: 6:

- $SST = a_0 + a_1 T_{31} + a_2(T_{31}-T_{32})\, T_{sfc} + a_3(\sec(\theta)-1)(T_{31}-T_{32})$
  $+ a_4(fn(\text{mirror.side})) + a_5(\theta)$
  $+ a_6(\theta)^2$
- $SST4 = a_0 + a_1 T_{22} + a_2(T_{22}-T_{23}) + a_3(\sec(\theta)-1)$
  $+ a_4(fn(\text{mirror.side})) + a_5(\theta) + a_6(\theta)^2$

- Quality flagging improved

BUOY MATCHUPS



Matchups between Aqua MODIS and drifters, after QA, for 2012. 79986 for day & night, but spatial distribution is uneven.

Buoy measurements are of a subsurface temperature.

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TERRA MODIS SST RESIDUALS

MODIS TERRA – SST residual statistics for each quality level (day + night)

Quality	Min	Q1	Median	Mean	Q3	Max	RMS	SD	MAD
0	-4.461	-0.359	-0.109	-0.110	0.137	6.080	0.453	0.439	0.368
1	-5.170	-0.574	-0.209	-0.244	0.114	10.851	0.715	0.672	0.507
2	-7.573	-1.457	-0.779	-1.040	-0.283	5.525	1.598	1.214	0.833

MODIS TERRA – SST4 residual statistics for each quality level (night only)

Quality	Min	Q1	Median	Mean	Q3	Max	RMS	SD	MAD
0	-4.475	-0.292	-0.140	-0.163	-0.007	4.664	0.359	0.320	0.210
1	-4.756	-0.474	-0.223	-0.283	-0.027	4.703	0.529	0.447	0.324
2	-6.673	-1.071	-0.411	-0.641	-0.057	3.765	1.102	0.896	0.660

Expect mean error of -0.17K from skin effect

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AQUA MODIS SST RESIDUALS

MODIS AQUA – SST residual statistics for each quality level (day + night)

Quality	Min	Q1	Median	Mean	Q3	Max	RMS	SD	MAD
0	-4.546	-0.362	-0.131	-0.139	0.093	13.024	0.460	0.438	0.338
1	-5.882	-0.565	-0.208	-0.255	0.087	10.948	0.701	0.652	0.477
2	-7.231	-1.584	-0.851	-1.111	-0.323	8.764	1.639	1.202	0.885

MODIS AQUA – SST4 residual statistics for each quality level (night only)

Quality	Min	Q1	Median	Mean	Q3	Max	RMS	SD	MAD
0	-4.394	-0.312	-0.152	-0.183	-0.013	3.961	0.385	0.339	0.219
1	-5.178	-0.597	-0.292	-0.381	-0.074	3.473	0.640	0.514	0.372
2	-7.684	-1.871	-1.041	-1.235	-0.348	4.111	1.703	1.172	1.101

Expect mean error of -0.17K from skin effect

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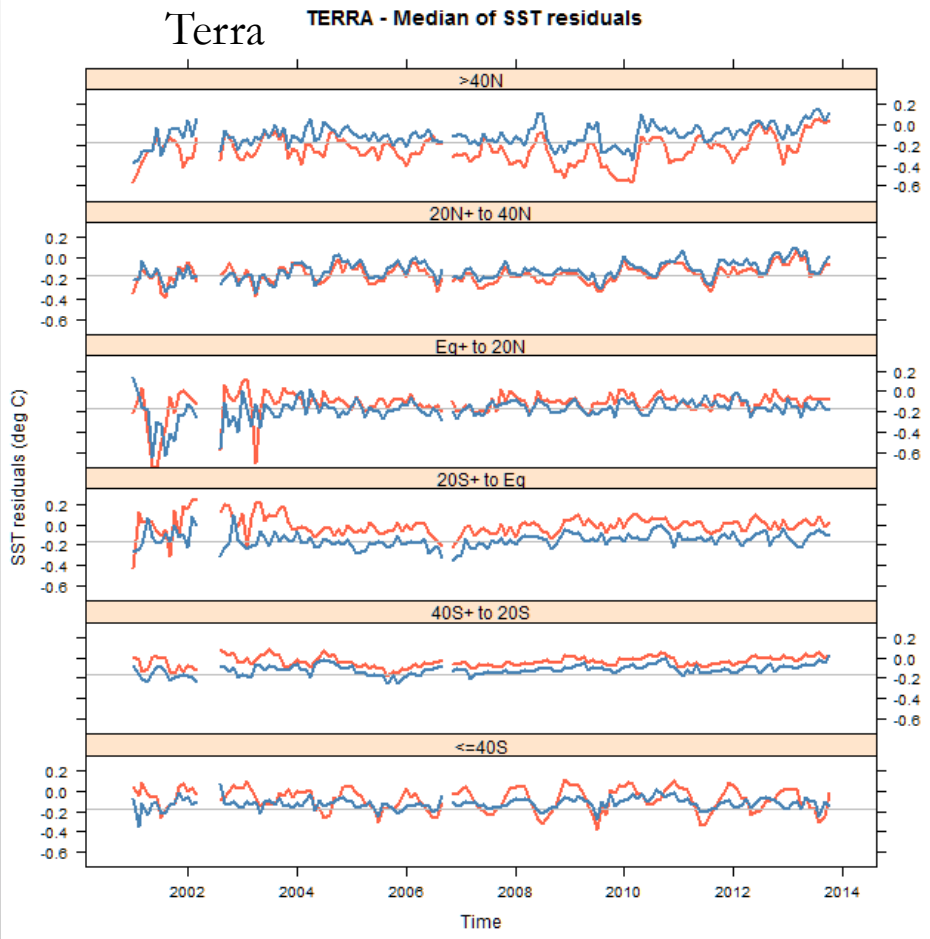
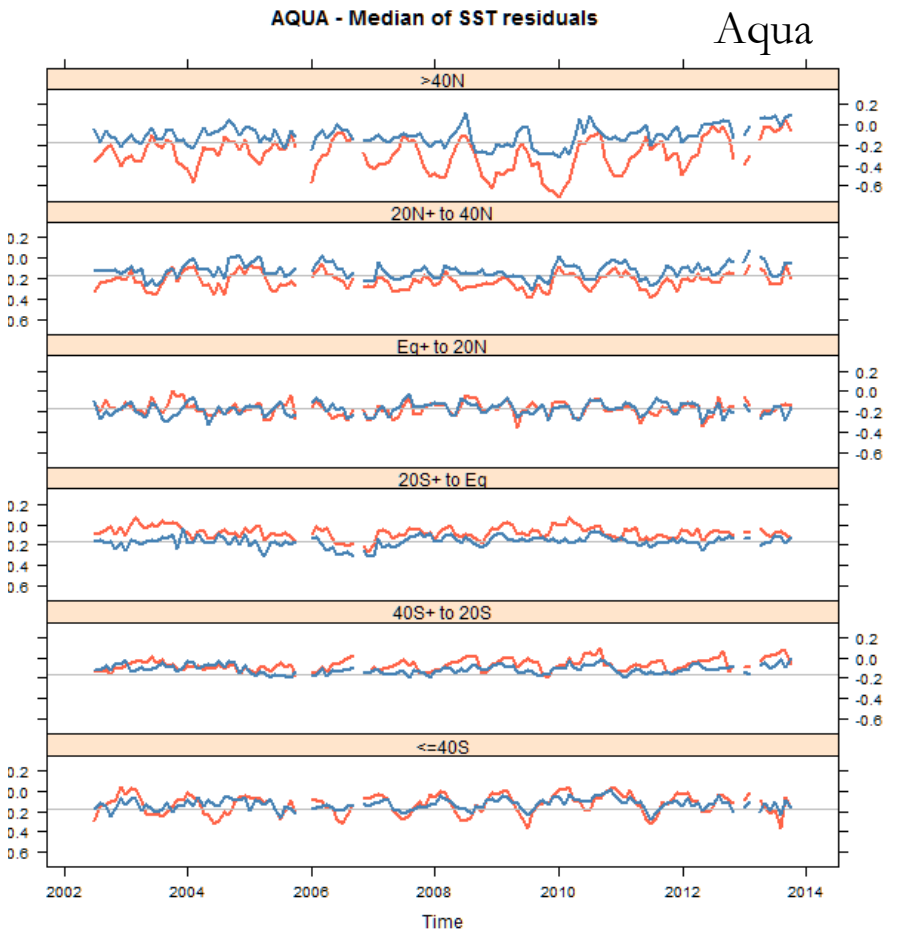
MEDIAN OF SST ERRORS

Terra



Aqua



Collection 5 – red. Collection 6 - blue

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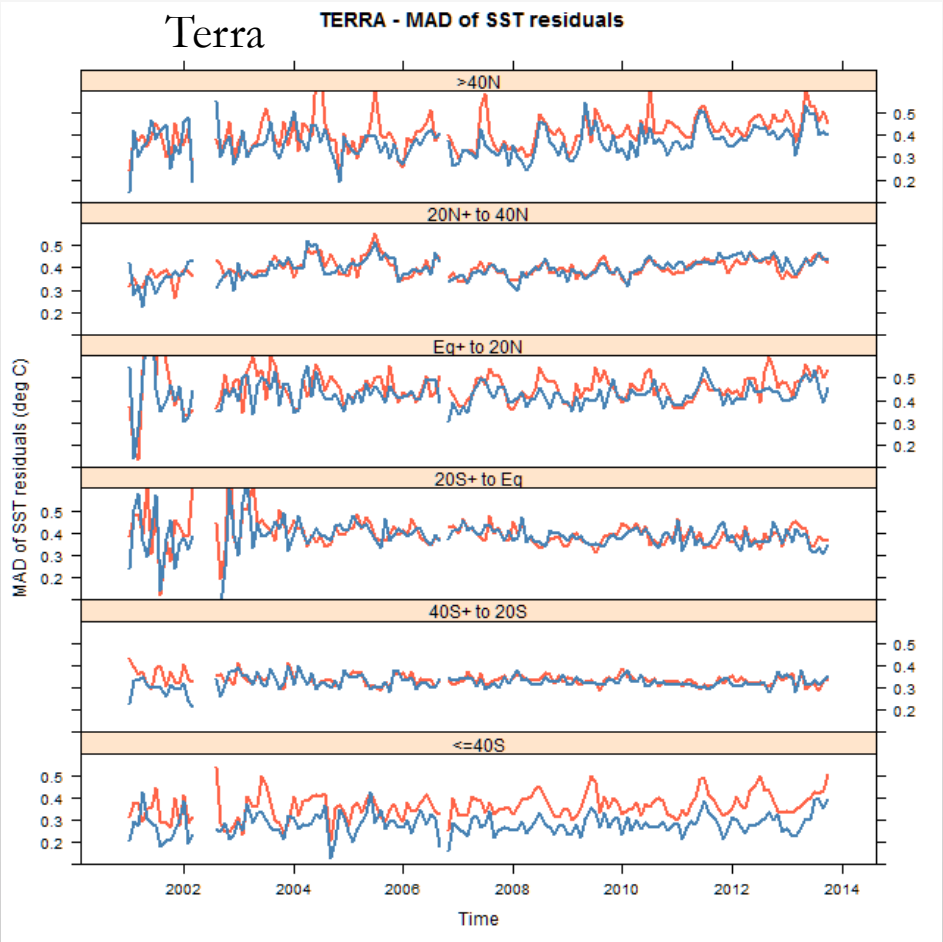
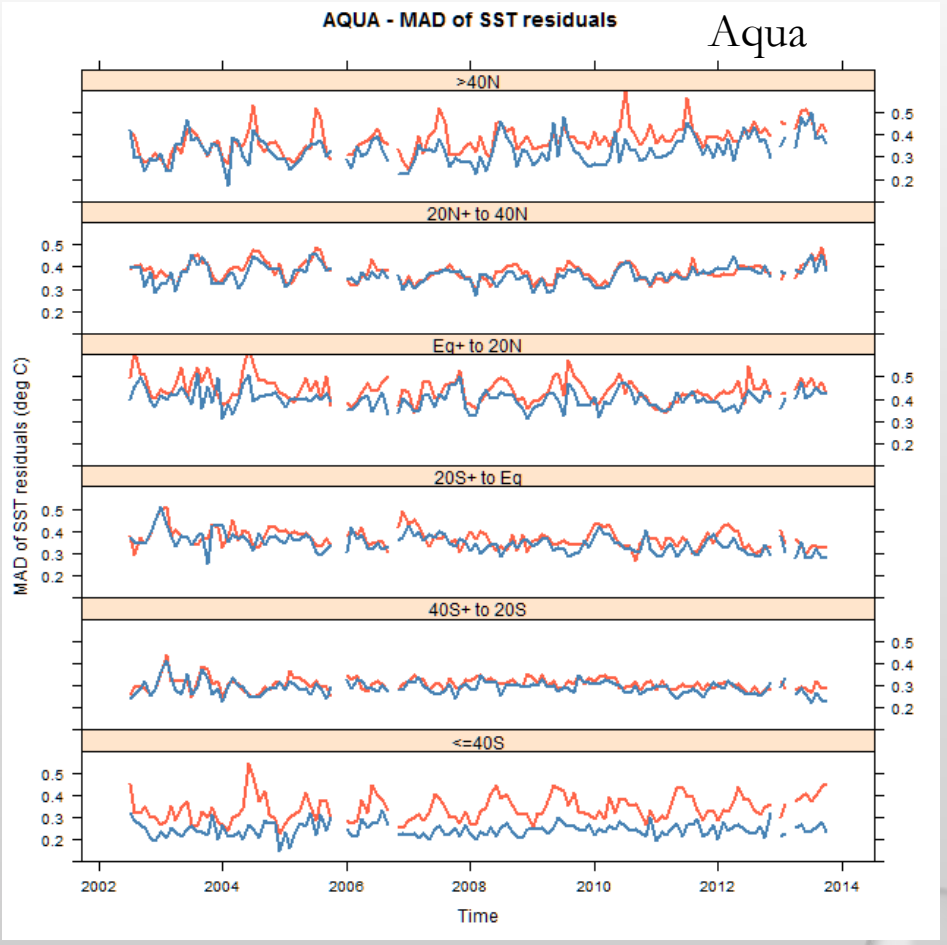
MEAN ABS DIFFS OF SST ERRORS

Terra



Aqua



Collection 5 – red. Collection 6 - blue

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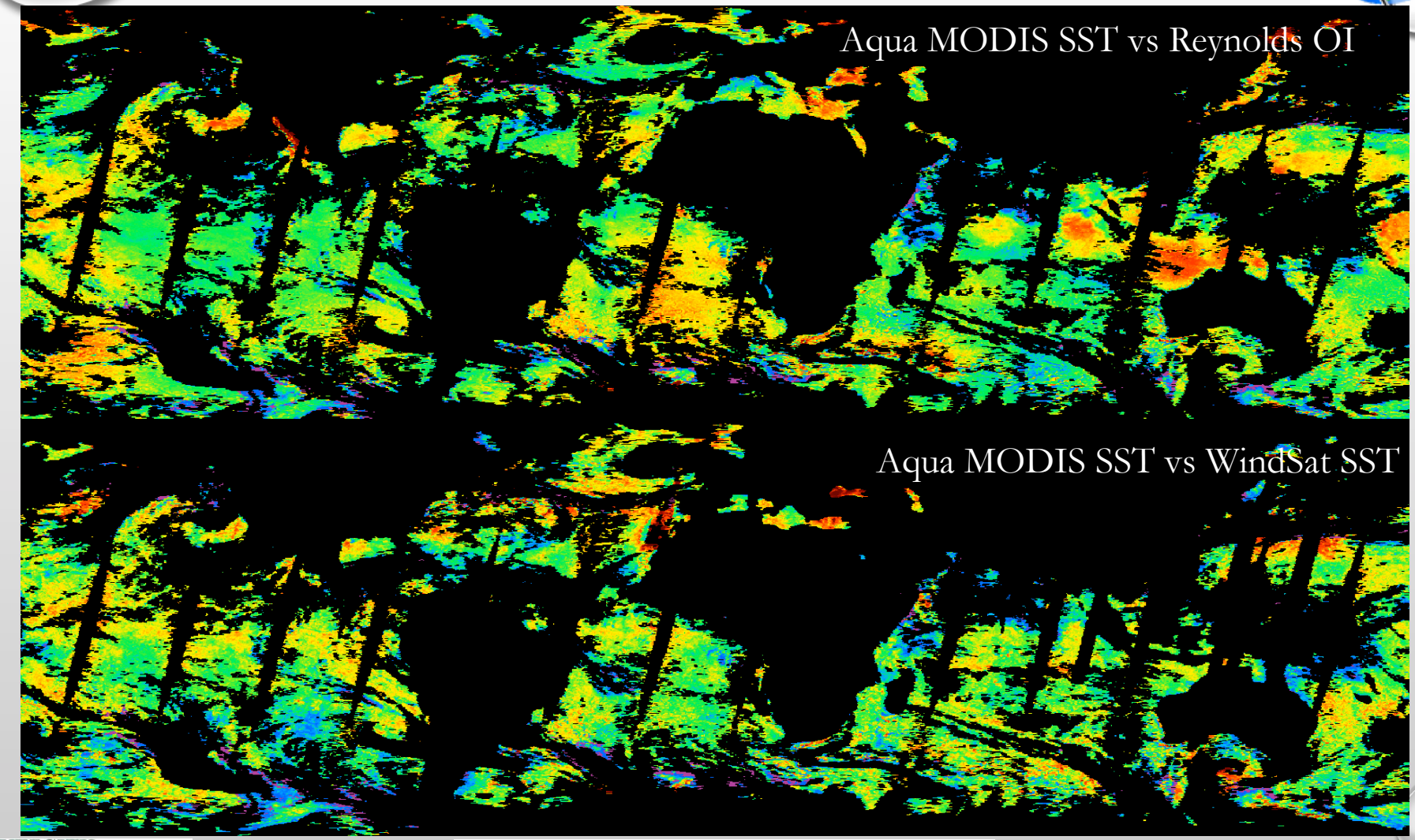
COMPARISON WITH OTHER SSTS



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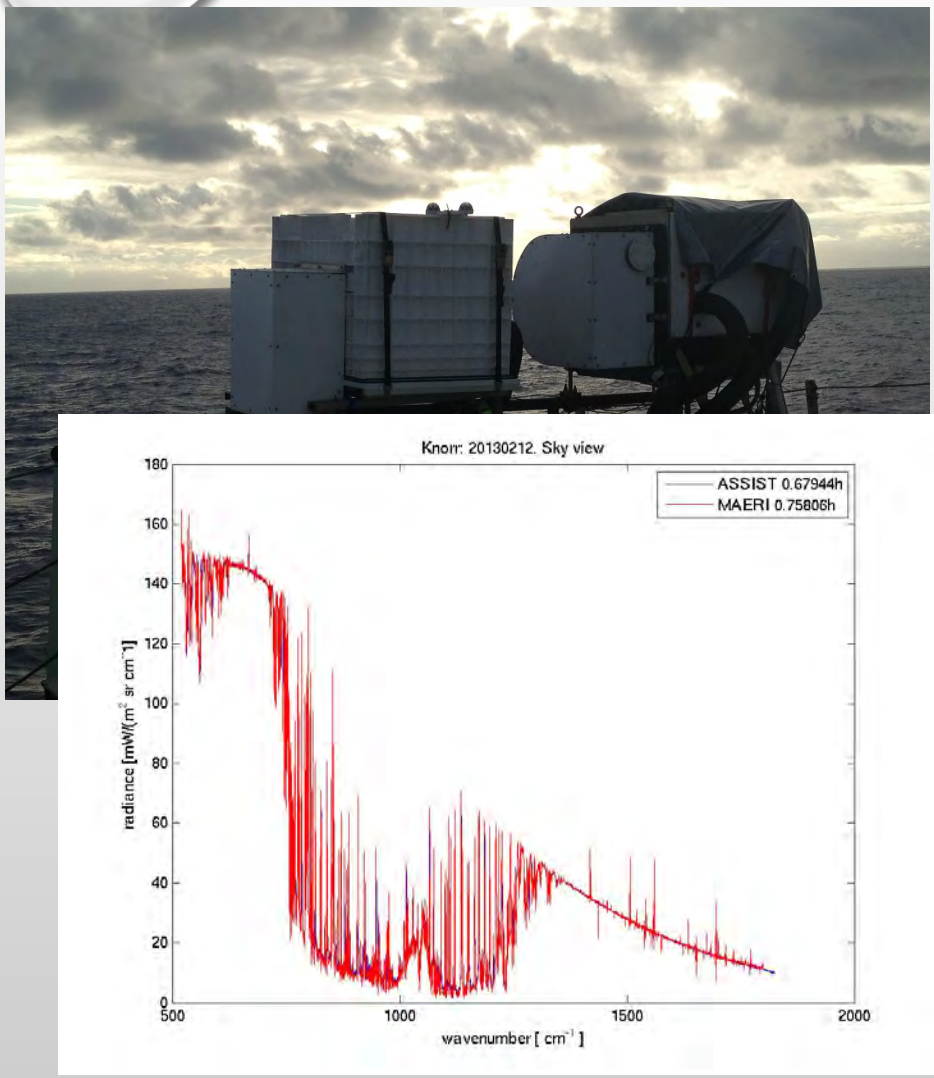
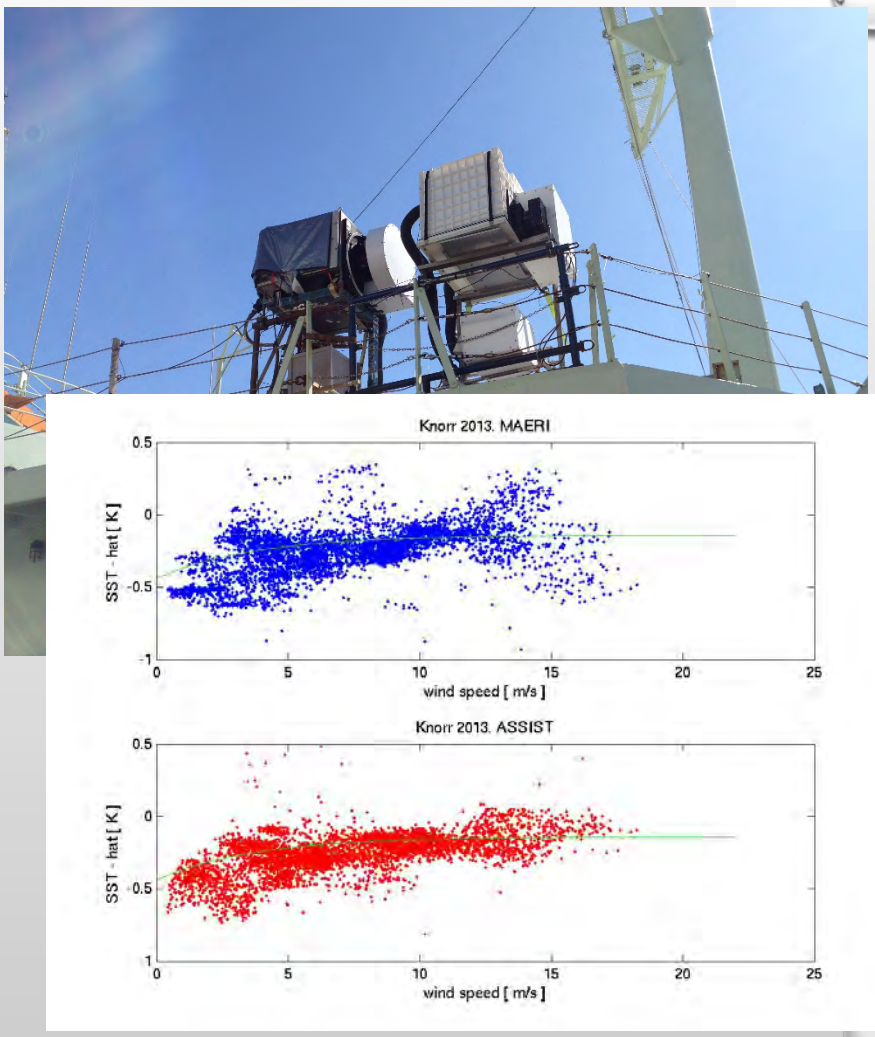
RADIOMETERS AT SEA





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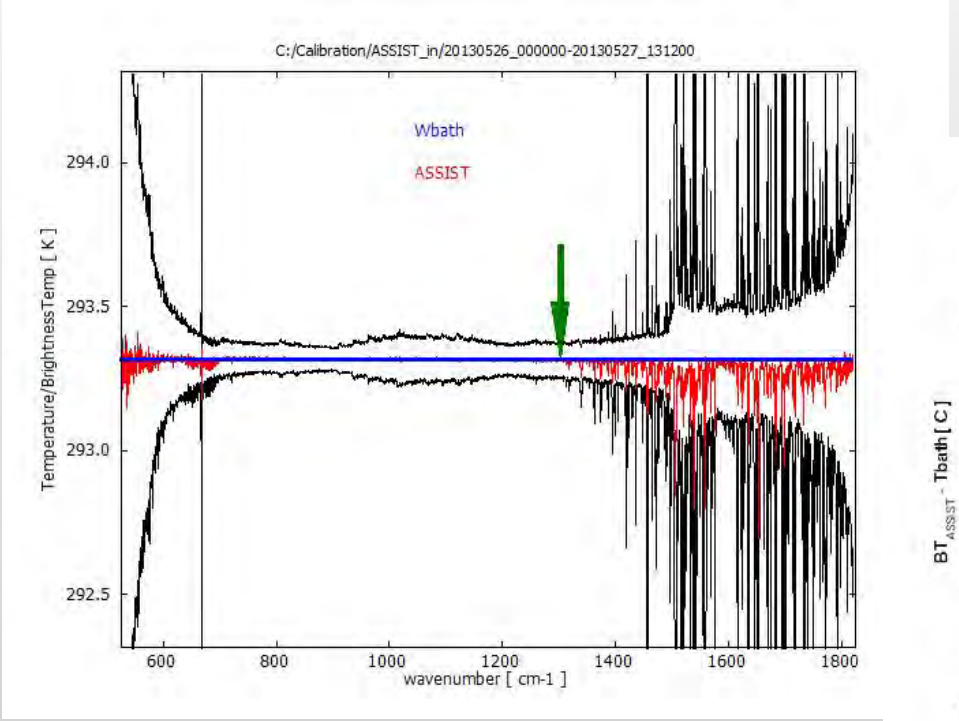
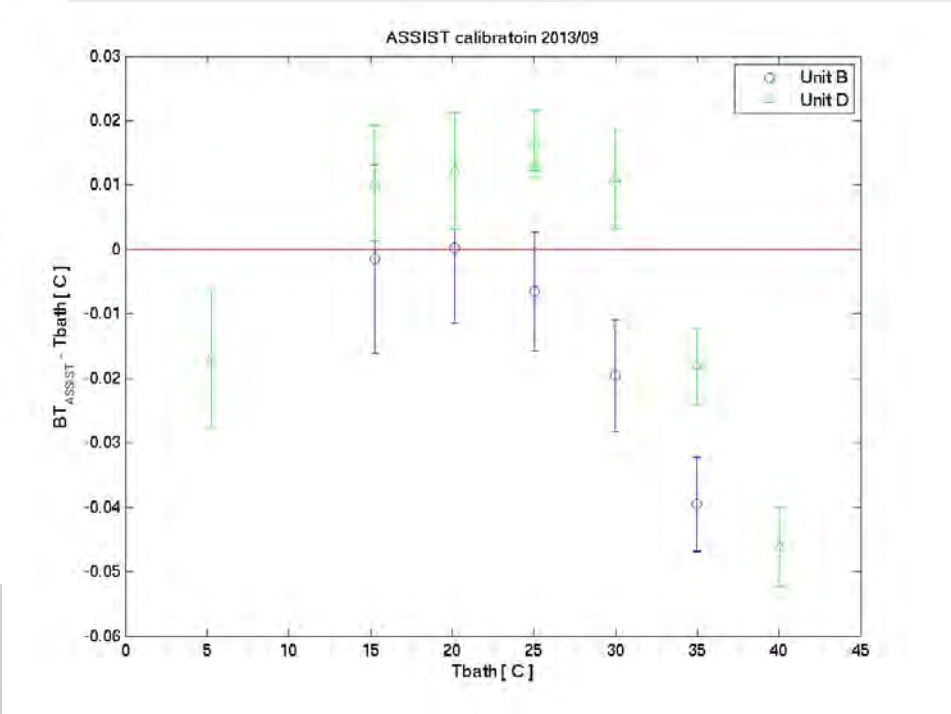
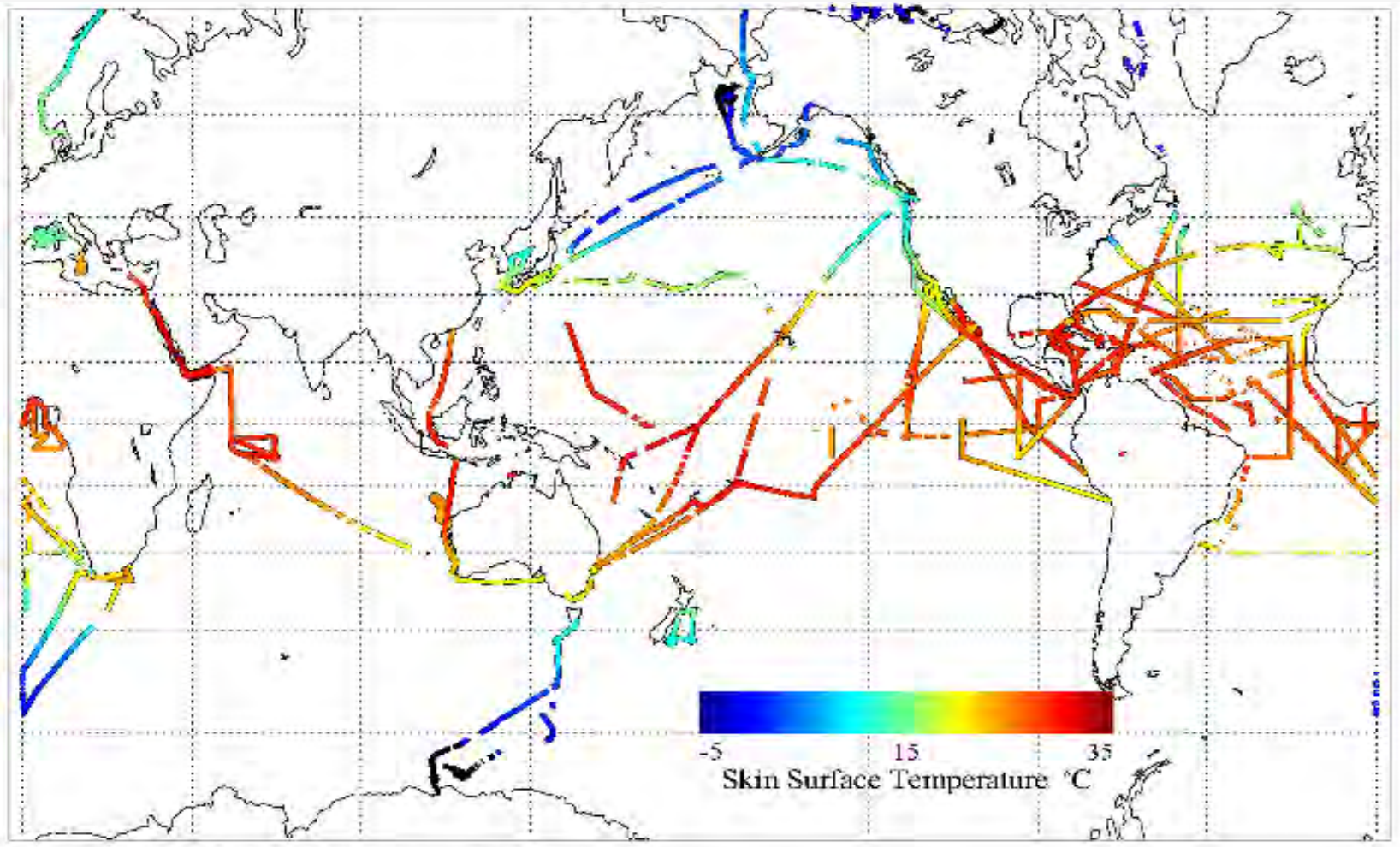
Mean difference between M-AERI SSTs =0.064K

M-AERI CALIBRATION





M-AERI DEPLOYMENTS



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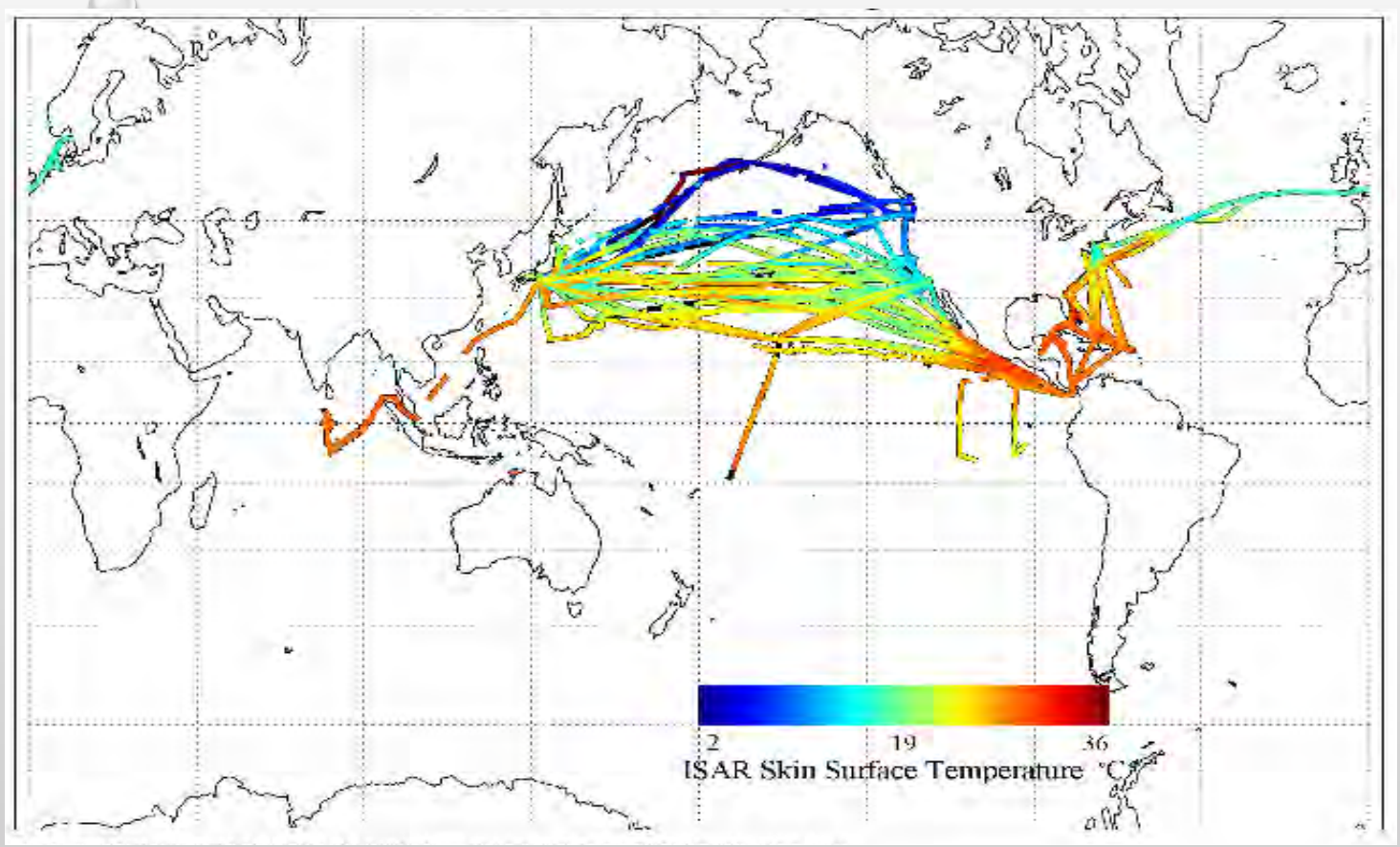
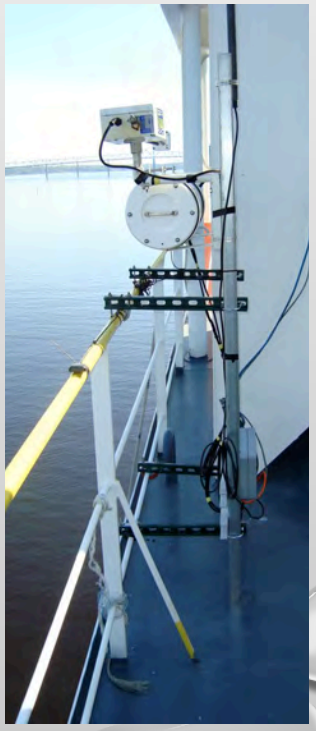
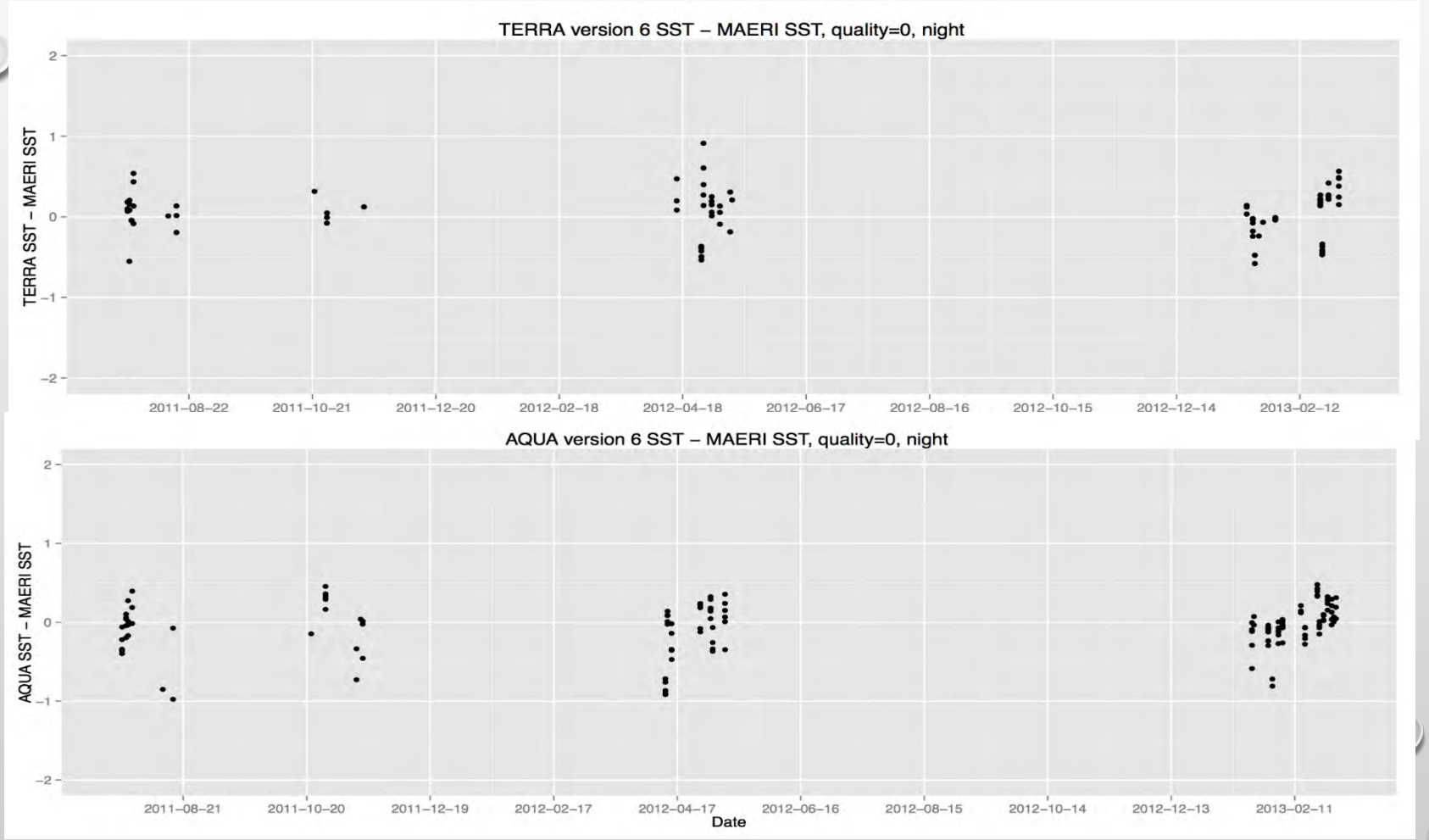
ISAR DEPLOYMENTS





MODIS – M-AERI SKIN SSTS



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GLOBAL STATS *vs* RADIOMETERS

MAERI	SST4 V6					
	mean	median	sd	mad	IQR	N
TERRA	0.047	0.082	0.297	0.227	0.291	84
AQUA	-0.056	-0.024	0.304	0.242	0.308	135
MAERI	SST night V6					
	mean	median	sd	mad	IQR	N
TERRA	-0.076	-0.073	0.444	0.492	0.627	93
AQUA	-0.087	-0.023	0.428	0.305	0.418	133

ISAR	SST4 V6					
	mean	median	sd	mad	IQR	N
TERRA	0.110	0.085	0.618	0.289	0.388	662
AQUA	-0.017	0.016	0.373	0.270	0.414	369
ISAR	SST night V6					
	mean	median	sd	mad	IQR	N
TERRA	0.003	0.044	0.716	0.525	0.727	798
AQUA	0.059	0.066	0.495	0.384	0.521	355

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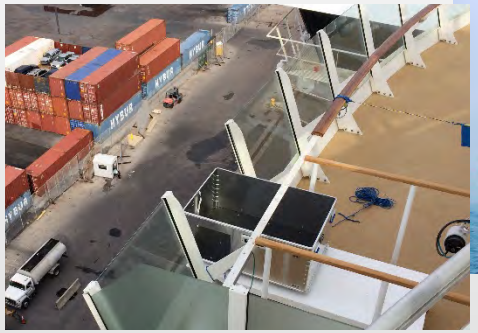
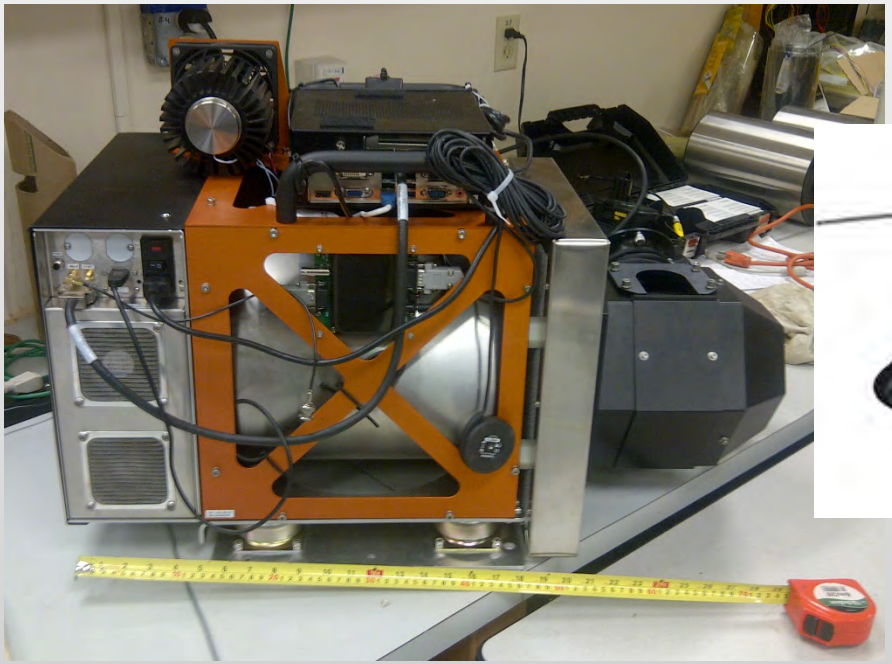
M-AERI Mk2

- Three M-AERI Mk2s being deployed on RCCL cruise liners….

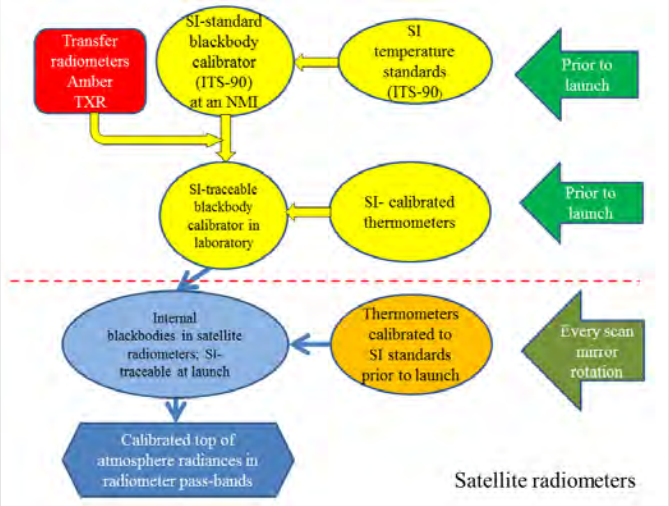


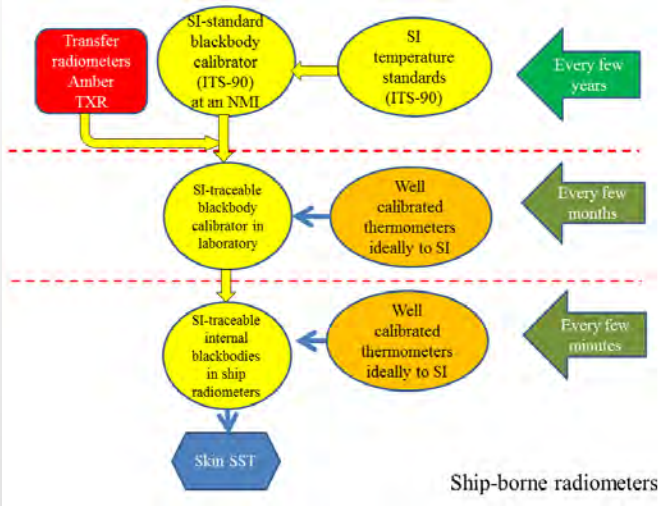
M-AERI Mk3

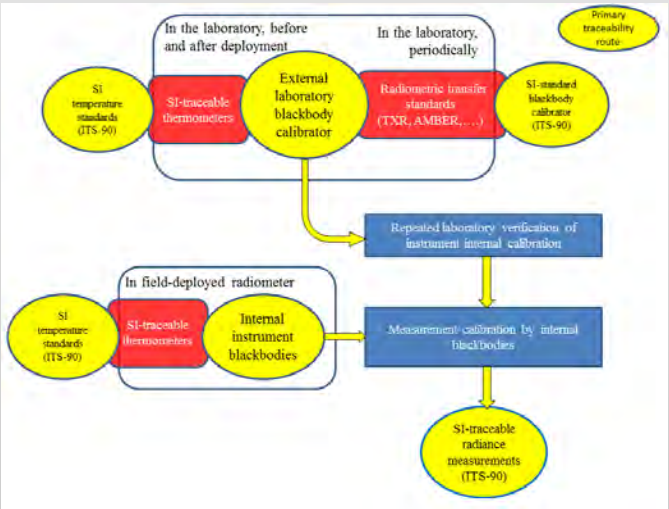
M-AERI Mk 3 small enough to be helicopter mounted….

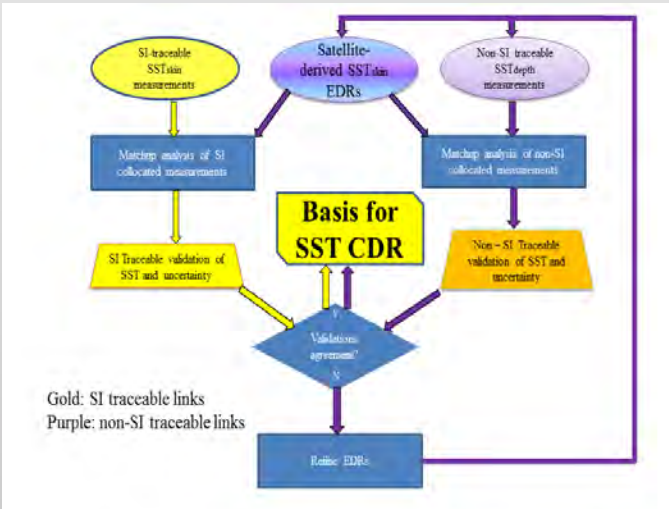


CDR GENERATION









LOOKING FORWARD

- Minor improvements to algorithms
- Forward solution – optimum estimation of skin SST
- Evaluate sampling errors resulting from clouds
- Better partitioning of sources of uncertainties to derive improved estimate of MODIS SST accuracies
- Continue at-sea deployments……
- Continue to grow MUDBs to demonstrate stability of MODIS SSTs…
- Ensure MODIS and VIIRS SSTs are compatible and can contribute to the SST CDR
- Not seek the 8th significant figure in SST

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